SMOKING STATUS AND BODY COMPOSITION, EXERCISE, DIETARY INTAKE, AND ALCOHOL / CAFFEINE CONSUMPTION

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Report No. 91-22

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BETHESDA, MARYLAND

Smoking Status and Body Composition, Exercise, Dietary Intake, and Alcohol/Caffeine Consumption[1]

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[1] Report No. 91-22, supported by the Naval Military Personnel Command (Work Order No. N0002291WRWW549) and by the Naval Medical Research and Development Command (Work Unit 63706N M0095.005-6106), Department of the Navy. The views expressed in this article are those of the authors and do not reflect the official policy or position of the Department of the Navy, Department of Defense, or the U.S. Government. Approved for public release, distribution unlimited.

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Executive Summary

Problem

Research on smoking status and differences in body composition reveals conflicting results. Although the extant literature is both inconclusive and incomplete, it appears that dietary intake, alcohol consumption, exercise, whether one is a light/moderate or heavy smoker, and the recency of smoking cessation are important variables to investigate. Studies that simultaneously investigate all of these variables are not available.

Objective

The primary objective of the present study was to assess the relationships between smoking status and body composition, exercise, dietary intake, and alcohol and caffeine consumption.

Approach

Data from 1,820 Navy men were examined. Body composition measurements were obtained as part of the Navy's Physical Readiness Test. Smoking, exercise, and dietary intake (including alcohol and caffeine consumption) were assessed using a "life-style" survey. Analyses of variance were performed to examine the relationships between smoking status and the outcome measures of body composition, exercise, and dietary intake. All outcome measures were age-adjusted prior to computing analyses of variance.

Results

Of the five body composition variables, only lean body mass produced a significant overall F-value ($p<.05$). Although general mean patterns indicated small trends for smokers to have the lowest weight, lean body mass, and body mass index values, post-hoc analyses produced no significant group differences. There was a curvilinear relationship between weight and smoking status with light/moderate smokers weighing the least of all groups. Results of the analyses on caloric expenditure revealed a "dose-response" relationship with the heaviest smokers exercising the least and the never smokers exercising the most. With respect to the dietary variables, heavy smokers tended to eat high-fat meat more often, and eat lean meat, leafy vegetables, fruit, and fiber less often than all other groups. Long-term quitters were more similar to never smokers and short-term quitters were more similar to light/moderate smokers in eating patterns and consumption of low-fat foods. Drinking and smoking habits were positively associated, i.e., heavy smokers drank about twice as much alcohol and caffeine as never smokers and former smokers.

Conclusions

In this study smoking was associated with higher percentages of body fat, very low levels of exercise, a high-fat diet, and heavy consumption of alcohol and caffeine. All of these behaviors are associated with the leading causes of death and disability in the United States. Moreover, in those individuals who smoke, not only does smoking have an adverse effect on health and physical readiness, but other behaviors associated with smoking may exacerbate the effects of smoking and create additional detrimental health effects. Health promotion efforts undertaken by the Navy should continue to strongly encourage smokers to quit as well as to attempt to modify the other negative health behaviors that may accompany addiction to nicotine.

Introduction

There is ample evidence that cigarette smokers weigh less than comparably aged nonsmokers (Gordon, Kanrel, Dawber, & McGee, 1975; Jacobs & Gottenborg, 1981; USPHS, 1988) and that a curvilinear relationship exists with moderate smokers (smoking typically 10-20 cigarettes per day) having lower body weights and heavy smokers (smoking typically 20 or more cigarettes per day) having body weights approaching those of nonsmokers (Albanes, Jones, Micozzi, & Mattson, 1987; Fehily, Phillips, & Yarnell, 1984; Goldbourt & Medalie, 1977; Hjermann, Helgeland, Holme, Lund-Larsen, & Leren, 1976). However, the effects of smoking cessation on body weight are less clear. In the 1990 report of the Surgeon General, 15 prospective epidemiologic studies of the effects of smoking cessation on body weight change were reviewed. The average weight gain attributed to cessation of smoking was about 1.8 kg (4 lb) in both sexes, but individual responses ranged from weight loss to weight gain exceeding 20 pounds (USDHHS, 1990). The studies reviewed were not without methodological problems, however, including self-reports of body weight, short duration of study, high attrition rates, and the participation of subjects with previously diagnosed heart disease, pregnant women, paid volunteers, and subjects enrolled in risk-reduction programs (USDHHS, 1990).

In a recently reported study by Williams et al. (1991), a national cohort of adults was followed for 10 years to determine the effects of smoking cessation on weight gain. The cohort included continuing smokers and those who had quit smoking for a year or more. The mean weight gain after cessation of smoking was 2.8 kg in men and 3.8 kg in women. By the end of the study, smoking cessation had raised the mean body mass index of the average quitter to that of subjects who had never smoked. Among recent quitters (<1 year) the mean weight gain was lower than among the sustained quitters (>1 year). This study, however, did not

examine dietary practices or exercise patterns that can change the energy balance equation and may have an effect on the smoking and body weight relationship.

Very few studies have simultaneously evaluated all the mechanisms of weight gain in subjects who quit smoking, including energy intake, energy expenditure, and physical activity. Stamford, Matter, Fell, and Papenek (1986) assessed changes in dietary intake, physical activity, and resting metabolic rate in 13 sedentary females who quit smoking for a 48-day period. Mean daily dietary intake increased by 227 kilocalories and explained 69% of the variance in changes in weight. For the 13 subjects an average gain of 2.2 kg was observed in 48 days. It was reported that 96% of the weight gained was in the form of fat. Constituents of the diet did not change (e.g., protein, fats, carbohydrates) even though subjects reported a perceived increase in the consumption of sweets. The mean daily consumption of alcohol during the baseline period was 62 kcal and during cessation it was 55 kcals. No changes in physical activity or resting metabolic rate were observed.

Hall, McGee, Tunstall, Duffy, and Benowitz (1989) investigated the changes in food intake and physical activity in 95 subjects who enrolled in a stop-smoking program. At 12 weeks, men had gained an average of 5.09 lb and women had gained an average of 5.81 lb. Both sugar and fat increases were reported for the subjects that gained the most weight. Dallosso and James (1984) assessed whether the food intake and resting metabolic rate (RMR) of a group of smokers (n=10) changed when they gave up smoking. At the end of six weeks all subjects gained a significant amount of weight (1.36 kg). Lastly, Rodin (1987) evaluated changes in dietary intake and physical activity in 24 subjects who quit smoking and 18 smokers who failed in their attempts to quit smoking. Of the subjects who successfully stopped smoking, 14 gained weight and 10 stayed the same or decreased over the course of the experiment. Those subjects who stopped smoking

and gained weight increased the percentage of calories taken as sugar in their diet.

In addition to the mixed findings surrounding the role of diet and exercise on body weight after the cessation of smoking, the literature also reflects inconclusive findings on the factors that sustain body weight differences between smokers and nonsmokers. For example, investigations of the body-weight differences between smokers and nonsmokers indicate that the total dietary intakes of smokers are either the same as (Jacobs and Gottenborg, 1981; Fehily, Phillips, and Yarnell, 1984; Fisher and Gordon, 1985; Kannas, 1981; Matsuya, 1982) or higher than nonsmokers (Picone, Allen, Schramm, and Olsen, 1982; Stamford, Matter, Fell, Sady, and Cresanta, 1984a; Stamford, Matter, Fell, Papenek, and Cresanta, 1984b; Albanes, Jones, Micozzi, and Mattson, 1987). Of the studies assessing the effects of smoking on exercise, Conway and Cronan (1990) reported that never smokers and former smokers engaged in significantly more exercise sessions and expended more exercise kilocalories per week than did current smokers. One study reported similar findings (Kannas, 1981) and others reported that smokers' levels of physical activity were the same as nonsmokers (Stamford, Matter, Fell, and Papanek, 1984b; Gyntelberg and Meyer, 1974; Stephens and Pederson, 1983).

While it appears that there are body weight differences between smokers and nonsmokers, a number of issues remain unclear. For example, very few studies have examined differences in specific measures of body composition (e.g., percent body fat, lean body mass) between smokers, former smokers, and current smokers. In addition, the weight of former smokers are frequently compared to the weight of current smokers who smoke various amounts of cigarettes a day. As mentioned above, several studies have found that a curvilinear relationship exists between smoking status and weight. Simply comparing former smokers with current smokers without taking into account amount smoked by current smokers, may blur a more

complex relationship. Klesges, Eck, Isbell, Fulliton, and Hanson (1990b) reported that smokers have a lower estimated body fat than nonsmokers. However, former smokers and differences in the amount smoked by current smokers were not considered in this investigation. Other studies that have investigated body composition differences have reported increases in body fat or increases in body mass that have resulted from short-term cessation (Stamford et al., 1986; Tuomilehto, Jalkanen, Salonen, & Nissinen, 1985). The vast majority of studies of the effects of smoking on body weight report differences as pounds gained or pounds lost as a result of cessation (Klesges, Meyers, Klesges, & LaVasque, 1989).

Reports regarding the role of dietary intake in postcessation weight gain are also mixed. Stamford et al. (1986) reported strong support for the role of dietary intake, Rodin (1987) reported no changes in total dietary intake, Hall et al. (1989) found mixed support, and most recently, Klesges, Eck, Clark, Meyers, and Hanson (1990a) found that only females increased both their polyunsaturated and monounsaturated fat intake and decreased their fiber intake after short-term (3 weeks) cessation.

Lastly, very few studies have examined the role of physical activity in post cessation weight gain and those that have (Stamford et al., 1986; Rodin, 1987; Hall et al., 1989; Klesges et al., 1990b) have failed to find a relationship between smoking cessation and physical activity. Yet, as Klesges et al. (1990b) point out regarding the assessment of smoking cessation effects on body weight, physical activity must be included to fully investigate the energy balance equation.

Although the data examined in the present report represent only a cross-sectional view of the relationships between smoking status and factors related to body composition, a comprehensive set of variables was examined: exercise energy expenditure, eating patterns, food choices, alcohol and caffeine intake,

as well as various body composition parameters. Furthermore, when defining smoking status, recency of smoking cessation for former smokers and quantity of cigarettes smoked for current smokers were considered. The overall objective of the study was to assess similarities and differences across five smoking status groups (never smokers, long-term and short-term quitters, light/moderate and heavy smokers) in the outcome variables of body composition (body weight, percent body fat, body mass index, lean body mass, and percent deviation from ideal weight), energy expenditure (exercise kilocalories), dietary practices (eating patterns and food choices), and alcohol/caffeine consumption.

Method

Participants

Participants were a group of 1,820 men who volunteered to participate in a Navywide evaluation of physical fitness and health-related life-style behaviors. These men had been randomly selected during either 1987 or 1988 from the pool of active duty Navy personnel (see Conway, Trent, & Conway, 1989). Although women also had been included in the Conway et al., (1989) study, only about 12% of the total sample were female--as is characteristic of the Navy at large. Thus, women were not examined in this report because of the insufficient subgroup sizes for women when subdivided according to smoking status.

The average age of participants was 29.6 years (SD = 7.3) with a range from 17-54 years of age. Race/ethnic group composition included 77% Whites, 12% Blacks, 4% Hispanics, 5% Filipinos, and 2% of other race/ethnic origin. Only 8% of participants reported that they were not high school graduates, and 43% reported having at least some college education.

Measures

Participants completed a "life-style" questionnaire containing a broad range of health- and fitness-related questions regarding attitudes and behaviors as well as demographic items. The smoking status, exercise behavior, eating

patterns, dietary composition, and alcohol/caffeine measures described below were all derived from answers to the life-style questionnaire.

The body composition measures were derived from information collected as part of procedures required for the Navy's biannual Physical Readiness Test (PRT) under the Chief of Naval Operations Instruction OPNAVINST 6110.1C. As part of these procedures, several measures for assessing body composition were taken on each Navy member so that the percentage of body weight attributable to fat could be estimated (Hodgdon & Beckett, 1984a,b). These measures included height, weight, and several body circumferences (see below). The PRT data were collected by command fitness coordinators, stationed at participants' commands, who forwarded the data to the Naval Health Research Center in accordance with the requirements of this study.

Smoking Status

Subjects had to meet a number of criteria based on several questionnaire items to be classified either as a never smoker, former smoker, or current smoker. For example, subjects were asked whether or not they had smoked at least 100 cigarettes in their entire life, if they smoked now, whether they would classify themselves as a nonsmoker, light, moderate or heavy smoker, the recency of having had their last cigarette, and the number of cigarettes typically smoked per day during the last 30 days. Using responses to these questions, subjects were classified as being a never smoker, short- or long-term former smoker, or light/moderate or heavy smoker. Never smokers had to report that they had smoked less than 100 cigarettes in their entire life, did not smoke now, that they considered themselves nonsmokers, had never smoked cigarettes in response to the question about the most recent time they had had a cigarette, and that they did not smoke any cigarettes during the last 30 days. Former smokers were dichotomized as being long-term quitters (three or more years ago) or as short-term quitters (two years or less ago). Long-term former smokers had to have

reported smoking at least 100 cigarettes in their entire life, that they did not smoke cigarettes now, that they considered themselves nonsmokers, and that the most recent time they had smoked a cigarette was three years or more ago. Short-term former smokers had to have given the same responses as long-term quitters except that the most recent time they had reported smoking a cigarette was two years or less ago, but not "today." Current smokers were dichotomized based on the amount of cigarettes they usually smoked on a typical day during the last 30 days. Individuals who reported smoking 20 or fewer cigarettes per day were classified as light/moderate smokers and those who reported smoking 21 or more cigarettes per day were classified as heavy smokers.

Body Composition

Percent Body Fat. Percent body fat for males and females was estimated from height, measured without shoes, and several body circumferences using equations developed by Hodgdon and Beckett (1984a,b). The Navy uses these equations to estimate percent body fat as part of the medical screening procedures required prior to each service member taking the biannual Physical Readiness Test (PRT), which assesses several components of physical fitness (OPNAVINST 6110.1C). Two body circumferences were obtained for males: (1) neck circumference, measured around the neck with the tape passing just below the larynx, and (2) abdominal circumference, measured around the abdomen at the level of the umbilicus. In women, three body circumferences were taken: (1) neck circumference, measured the same as for men, (2) natural waist circumference, measured at the point of minimal abdominal circumference, and (3) hip circumference, measured with the tape passing over the greatest protrusion of the gluteal muscles.

Lean Body Mass. Lean body mass was computed from an individual's percent body fat and total body weight in pounds using the following equation: Lean Mass = [1.0 - (% Body Fat/100)] x Weight. This computation provides a measure of a person's total lean body weight (i.e., total weight minus fat

weight), and is an indirect indicator of overall body strength (Beckett & Hodgdon, 1987).

Body Mass Index. The body mass index was calculated after converting weight (W) and height (H) to metric units (kilograms and meters). The Body Mass Index (or Quetelet's Index) was computed as W/H^2.

Percent Deviation from Ideal Weight. The difference between the subject's weight and ideal weight was calculated for a person of medium frame and a given height (Metropolitan Life Foundation, 1983). The Metropolitan Life Height and Weight Tables range from 158 cm to 193 cm for men, and from 148 cm to 183 cm for women. Therefore, this measure was calculated only for participants within these height ranges. Percent deviation from ideal weight was then defined as:

% Ideal Weight = [(W - Ideal W) / Ideal W] x 100.

Exercise

Self-reported exercise activities also taken from the survey included reports on nine common exercise activities: running, continuous walking, swimming, bicycling, playing racket sports, aerobic dancing/exercising, weight lifting, performing calisthenics, and playing basketball. Two components for each of these activities were assessed: (a) frequency (i.e., times per week engaged in an exercise) and (b) duration (i.e., time spent exercising during a workout period). The frequency and duration measures for each of the nine exercise activities were also used to estimate the number of kilocalories expended per week in exercise activities. The tables of McArdle, Katch, and Katch (1986) were used to calculate kilocalories expended weekly on each of the exercise activities. Total number of exercise kilocalories expended per week was computed by summing the kilocalories expended across each of the nine exercise activities.

Dietary Patterns

Six items concerning eating patterns (e.g., frequency of eating breakfast, lunch, dinner, snacks, overeating, and fasting) were included (see items 1 through 6 under "Eating Patterns" in Appendix A). Response options were on a 5-point scale from "never this week" [coded 0], "1 or 2 times this week" [coded 1], "3 or 4 times this week" [coded 2], "5 or 6 times this week" [coded 3], to "every day this week" [coded 4].

Dietary Composition

Fifteen items concerning food choices and frequency of consuming different types of food were included (see items 1 through 15 under "Dietary Composition" in Appendix A). Response options were on a 7-point scale from "never this week" [coded 0], "1 or 2 times this week" [coded 1], "3 or 4 times this week" [coded 2], "5 or 6 times this week" [coded 3], "once every day this week" [coded 4], "twice every day this week" [coded 5], to "3 or more times every day this week" [coded 6].

Alcohol and Caffeine Consumption

Two items were used to calculated weekly alcohol consumption. The number of days during the last seven days in which the participant reported drinking any alcoholic beverage was multiplied by the number of drinks typically consumed on those days. Daily caffeine consumption was indicated by three individual items which asked about the average number of cups or glasses of caffeinated coffee, caffeinated cola or carbonated drinks, and caffeinated tea consumed per day.

Statistical Analysis Procedures

One-way analysis of variance was used to test for differences among never smokers, short- and long-term quitters, and light/moderate and heavy smokers on the outcome variables of body composition, physical activity, dietary patterns, dietary composition, and alcohol/caffeine consumption. Post-hoc analyses were performed using the modified least squares procedure (SPSSX, 1988). Only group

differences significant at the $p < .05$ level are reported unless otherwise indicated.

Prior to conducting the one-way analyses of variance and post hoc comparisons, the outcome variables were adjusted for age. Each outcome measure was regressed on age and the resulting residual saved; the outcome variable mean was then added to each residual to obtain the age-adjusted scores used in further analyses. This adjustment was made to avoid any possible confounding of results due to correlations between age and smoking status, body composition, dietary patterns and intake, or substance consumption. Complete descriptive statistics for all age-adjusted outcome variables are provided by smoking status groups in Appendix B.

RESULTS

Body Composition

Age-adjusted means for the body composition variables for all groups can be seen in Table 1. Of the six body composition variables only lean body mass produced a significant overall F-value ($p<.05$). Small trends in the means indicated that smokers tended to have the lowest weight ($p = .054$), lean body mass ($p = .033$), and body mass index ($p = .077$); however, post-hoc analyses indicated that no group differences (not even for lean body mass) were significant at $p<.05$.

Exercise

Also indicated on Table 1, results of the analysis of caloric expenditure revealed a "dose-response" relationship with the heaviest smokers exercising the least and the never smokers exercising the most. Post hoc analysis revealed that heavy smokers exercised less than all other groups, that moderate smokers exercised less than long-term quitters and never smokers, and that short-term quitters exercised less than never smokers.

Table 1. ANOVA results and age-adjusted group means for body composition and exercise by smoking status

	SMOKING STATUS						
Outcome Variables	Never Smoked	Long-Term Quitter	Short-Term Quitter	Light/ Moderate Smoker	Heavy Smoker	F Ratio	Prob.
BODY COMPOSITION							
Height (in.)	70.07	70.10	69.87	69.83	70.23	1.10	.351
Weight (lb)	177.12	179.60	176.68	173.09	175.58	2.32	.054
Percent Body Fat (%)	15.87	16.44	16.48	15.65	16.20	1.48	.204
Lean Body Mass (lb)	148.36	148.83	146.86	145.09	146.05	2.61	.033
Body Mass Index	24.85	25.13	24.85	24.46	24.55	2.10	.077
Percent Deviation Ideal Weight (%)	10.53	11.52	11.14	9.62	9.81	.64	.631
EXERCISE							
Kilocalories Expended (Kcals)	3432.08	3355.59	2767.64	2530.85	1850.15	23.09	.001

Eating Patterns

Inspection of Table 2 reveals that smokers ate breakfast less often than any other group. Heavy smokers ate lunch less often than never smokers and long-term quitters, and heavy smokers also ate dinner less often than never smokers. Lastly, there was an overall group effect for fasting with higher means for heavy and light/moderate smokers, although post hoc analyses did not indicate any significant group differences at $p<.05$.

Dietary Composition

With respect to dietary composition, it can be seen in Table 3 that smokers added salt to food more often than any other group, and heavy smokers added salt more often than light/moderate smokers. Heavy smokers also tended to eat more high fat meat, and eat lean meat, leafy vegetables, fruit, and fiber less often than all other groups. Heavy smokers also ate fish less often than never smokers, and ate fried foods more often than long-term quitters. Light/moderate smokers ate fruit less often than long-term quitters and never smokers, and ate fiber less often than long-term quitters. Smokers in general ate low-fat dairy products less often and ate butter more often than never smokers and long-term quitters. Short-term quitters ate high-fat dairy products less often than smokers and never smokers. Never smokers in general ate refined sugar products more often than other groups, and post hoc analyses revealed a significant difference between never smokers and light/moderate smokers.

Alcohol and Caffeine Consumption

As indicated in Table 4, smokers in general consumed markedly more alcohol as well as more caffeine than other groups. Heavy smokers also drank more caffeinated cola and carbonated drinks than any of the nonsmoking groups. Finally, heavy smokers drank significantly more tea than never smokers.

Table 2. ANOVA results and age-adjusted group means for dietary patterns by smoking status

	SMOKING STATUS						
	Never Smoked	Long-Term Quitter	Short-Term Quitter	Light/ Moderate Smoker	Heavy Smoker	F Ratio	Prob.
Outcome Variables							
DIETARY PATTERNS							
Breakfast	2.07	2.18	2.02	1.65	1.23	28.64	.001
Lunch	3.06	3.10	2.95	2.86	2.74	5.74	.001
Dinner	3.57	3.48	3.43	3.40	3.31	3.21	.012
Fasting	.09	.06	.09	.14	.15	2.72	.027
Snacking	1.88	1.79	1.68	1.75	1.78	1.30	.267
Overeat	.54	.63	.63	.47	.54	1.96	.096

Table 3. ANOVA results and age-adjusted group means for dietary composition by smoking status

Outcome Variables	SMOKING STATUS: Never Smoked	Long-Term Quitter	Short-Term Quitter	Light/ Moderate Smoker	Heavy Smoker	F Ratio	Prob
DIETARY COMPOSITION							
Salt	1.67	1.66	1.80	2.33	2.81	23.13	.001
High-Fat Meats	1.90	1.77	1.88	2.05	2.33	8.09	.001
Lean Meats	1.76	1.70	1.57	1.59	1.33	6.57	.001
Fish	1.00	1.00	.97	.91	.76	3.35	.009
High-Fat Dairy	2.12	2.07	1.75	2.16	2.33	3.86	.004
Low-Fat Dairy	1.34	1.50	1.09	1.04	.88	8.33.	.001
Butter, Lard, Fat on Meat	1.38	1.21	1.54	1.65	1.80	7.72	.001
Fried Foods	1.79	1.57	1.73	1.86	2.00	4.56	.001
Refined Sugar Products	1.70	1.54	1.67	1.42	1.51	3.79	.004
Vegetables	2.33	2.49	2.53	2.29	2.02	4.92	.001
Fruits	2.37	2.48	2.22	2.07	1.69	13.02	.001
Fiber	1.82	2.06	1.97	1.65	1.37	8.76	.001
Polyunsaturates	1.54	1.54	1.42	1.50	1.47	.35	.841
Eggs	1.33	1.32	1.42	1.33	1.31	.23	.920
Starches	2.12	2.16	2.07	2.11	2.15	.14	.964

Table 4. ANOVA results and age-adjusted group means for alcohol/caffeine consumption by smoking status

	SMOKING STATUS						
	Never Smoked	Long-Term Quitter	Short-Term Quitter	Light/ Moderate Smoker	Heavy Smoker	F Ratio	Prob.
Outcome Variables							
ALCOHOL/CAFFEINE CONSUMPTION							
Alcohol (drinks per week)	4.40	5.20	4.77	8.70	10.04	18.84	.001
Coffee (cups per day)	1.21	1.81	2.29	3.05	4.75	87.70	.001
Cola (drinks per day)	2.03	1.94	1.77	2.31	2.50	4.84	.001
Tea (glasses/cups per day)	.69	.77	.87	.82	1.11	2.39	.048

Discussion

The results of this investigation are fairly consistent with the findings of previous studies with respect to a trend for smokers to weigh less than nonsmokers. Also consistent with the literature on smoking and body weight was our finding that there is a curvilinear relationship between smoking status and weight, with those smoking 1-20 cigarettes/day being thinner and those smoking more than 21 cigarettes/day being heavier. Trends in our data indicated that the heavy smokers in this study had a body fat percentage that was higher than all other groups except former smokers. This was not surprising in light of significant findings indicating that heavy smokers ate foods high in fat more often, exercised less often, and consumed alcohol more often than any other group. Consistent with Jacobs and Gottenborg (1981), trends in our data also indicate that long-term quitters in general were heavier than those who never smoked.

Similar to other studies (Conway & Cronan, 1990; Klesges et al., 1990b) smokers in this study exercised less than nonsmokers. Particularly striking, however, was the finding that heavy smokers exercised almost 700 kcals less than even light/moderate smokers. The adverse effects of heavy smoking on a person's physical condition may make regular exercise more difficult to maintain. Light/moderate smokers were more similar to short-term quitters in kcals expended through exercise and long-term quitters were more like never smokers. These differences between light/moderate smokers and heavy smokers as well as differences between long-term and short-term quitters lends support for the importance of making finer distinctions among smokers and among quitters.

Of interest is the finding that long-term quitters were similar to never smokers and short-term quitters were more similar to light/moderate smokers in eating patterns (breakfast, lunch, dinner), consumption of low fat foods (lean meats, fish, low fat dairy, and fruit), and salt consumption. Healthier dietary

behavior among long-term quitters as compared to short-term quitters may reflect the tendency for long-term quitters to perceive themselves as nonsmokers and to adopt other healthier behaviors. The 1987 National Health Interview Survey reflected a similar finding in that former smokers were the most likely to report that they have changed their diet for the sake of their health. In addition, Orleans, Shipley, Wilbur, et al. (1983) found evidence of significant improvements in overall nutritional practices for former smokers. However, these studies did not distinguish between short- and long-term quitters, which our data suggests may be important for the better understanding of patterns of changes following cessation of smoking.

Contrary to other studies, our quitters did not consume significantly more sugar than other groups (Rodin, 1987). In fact, quitters tended to resemble never smokers in sugar consumption. Smokers, specifically light/moderate smokers, consumed the least amount of sugar. Consistent with previous studies (Fisher and Gordon, 1985; Gordon, and Kannel, 1983) drinking and smoking habits were positively associated. In fact, heavy smokers drank about twice as much alcohol and coffee as never smokers and former smokers.

Despite the strengths of this study (e.g., large sample size, multiple measures of body composition, thorough exercise and dietary intake data, and simultaneous measurement of these variables), discussion of possible limitations is in order. First, it must be acknowledged that there are some restrictions of range in our data by virtue of the fact that this sample consists of relatively young men, of whom 90% are between the ages of 18-40, who are employed, relatively healthy (i.e., no known disabilities or serious illnesses), who are required to meet at least minimally acceptable physical fitness standards, and who are not morbidly obese. The Navy's weight and physical fitness standards screen out extremely sedentary, "physically unfit" men as well as men who chronically exceed 26% body fat. Consequently, the men in this sample are a

slightly leaner group of individuals than typical American men. About 23% of these Navy men, compared to over 25% of American males, are 20% above their ideal weight (USDHHS, 1987). Navy restrictions prevent either extremely thin or extremely overweight individuals from entering the service and may partially explain why there were not stronger differences across groups on the body composition variables.

A second weakness is that the sample is comprised only of men. There are a number of differences between men and women on exercise (LaPorte, Montoye, & Caspersen, 1985), dietary practices (Beaton, Milner, Corey, et al., 1979), and other factors associated with the cessation of smoking (e.g., women smokers are generally thinner than men smokers, and women tend to gain more weight than men after cessation) (Klesges et al., 1990a). Future studies should attempt to determine the possible sex differences in factors influencing energy balance (e.g., diet, exercise, and metabolic rate) of smokers and nonsmokers.

Lastly, even though the data examined here are cross-sectional, we feel that the finer distinctions that this study presents between smokers and quitters may help researchers better understand the processes underlying the impact of smoking and changes in smoking status on body composition and perhaps the development of disease. The distinctions employed here might well be used in future prospective studies to determine if factors such as smoking, exercise, and diet have simple additive effects on health or whether they interact to have a synergistic impact. For example, are heavy smokers who are overweight, have unhealthy dietary patterns, consume large amounts of alcohol and caffeine, and are sedentary at substantially greater risk of developing disease due to these factors compared to nonsmokers? If so, would making improvements in diet and exercise, for example, compensate for some of the adverse effects of smoking? These questions and others may be best answered through prospective studies that incorporate all of the factors examined here.

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APPENDIX A

EATING PATTERNS (Scale: Never this week; 1 or 2 times this week; 3 or 4 times this week; 5 or 6 times this week; every day this week.

1. Eat breakfast
2. Eat lunch
3. Eat dinner
4. Eat snacks between meals
5. Overeat
6. Fast (not eat) an entire day

DIETARY COMPOSITION (Scale: Never this week; 1 or 2 times this week; 3 or 4 times this week; 5 or 6 times this week; twice every day this week; 3 or more every day this week.

During the last 7 days, how often did you ...?

1. add salt to your food at the table
2. eat high-fat meat (e.g., hamburger, hot dogs, steak, bacon, bologna, sausage)
3. eat lean meats (e.g., chicken or turkey without the skin, veal)
4. eat fish (e.g., fresh ocean or lake fish, canned tuna, salmon)
5. eat high-fat dairy products (e.g., whole milk, cream, cheeses, ice cream)
6. eat low-fat dairy products (e.g., low-fat milk or cottage cheese, yogurt)
7. eat (or cook with) butter, lard, or saturated fats (e.g., fat on meat)
8. eat polyunsaturated fats or oils (e.g., soft margarines, vegetable oils, nuts)
9. eat fried foods (e.g., french fries, fried chicken, fried eggs)
10. eat eggs or egg dishes (e.g., quiche, omelettes, egg salad)
11. eat refined sugar products (e.g., cakes, pies, cookies, candy)
12. eat "leafy" vegetables (e.g., broccoli, cauliflower, cabbage, greens)
13. eat "starchy" vegetables (e.g., beans, peas, corn, potatoes)
14. eat fruits (e.g., apples, oranges, dried fruits, raisins, melons, bananas)
15. eat high-fiber grains (e.g., whole wheat breads, oatmeal, bran cereals)

APPENDIX B

Descriptive statistics for outcome variables by smoking status

Outcome Variables		SMOKING STATUS: Never Smoked	Long-Term Quitter	Short-Term Quitter	Light/ Moderate Smoker	Heavy Smoker	Total
BODY COMPOSITION							
Height (in.)	MEAN	70.07	70.10	69.87	69.83	70.23	70.00
	SD	2.97	3.00	2.93	2.75	2.85	2.89
	N	580	217	148	512	285	1742
Weight (lb)	MEAN	177.12	179.60	176.68	173.09	175.58	175.81
	SD	25.23	28.56	26.53	27.03	29.15	26.83
	N	494	186	124	430	240	1474
Percent Body Fat (%)	MEAN	15.87	16.44	16.48	15.65	16.20	15.93
	SD	4.92	4.85	4.62	5.39	5.60	5.39
	N	574	217	147	507	283	1728
Lean Body Mass (lb)	MEAN	148.36	148.83	146.86	145.09	146.05	146.82
	SD	17.32	18.36	18.55	17.42	18.31	17.53
	N	458	184	123	427	237	1459
Body Mass Index	MEAN	24.85	25.13	24.85	24.46	24.55	24.71
	SD	2.86	3.08	2.66	3.08	3.27	3.04
	N	492	184	124	430	239	1469
Percent Deviation Ideal Weight (%)	MEAN	10.53	11.52	11.14	9.62	9.81	10.22
	SD	13.27	14.28	12.69	14.70	15.12	14.08
	N	460	145	963	471	831	171

Outcome Variables		Never Smoker	Long-Term Quitter	Short-Term Quitter	Light/ Moderate Smoker	Heavy Smoker	Total
EXERCISE							
Kilocalories Expended (Kcals)	MEAN	3432.08	3355.59	2767.64	2530.85	1850.15	2831.00
	SD	2876.47	2571.78	2277.94	2232.92	1789.95	2577.59
	N	558	209	142	472	267	1644
EATING PATTERNS							
Breakfast	MEAN	2.07	2.18	2.02	1.65	1.23	1.86
	SD	1.39	1.33	1.36	1.29	1.08	1.37
	N	594	228	155	531	302	1809
Lunch	MEAN	3.06	3.10	2.95	2.86	2.74	2.96
	SD	1.07	1.07	1.19	1.19	1.25	1.14
	N	593	227	155	530	302	1807
Dinner	MEAN	3.51	3.48	3.43	3.40	3.31	3.43
	SD	.80	.77	.91	.90	.94	.87
	N	594	227	155	531	302	1809
Fasting	MEAN	.09	.06	.09	.14	.15	.11
	SD	.43	.19	.41	.45	.37	.41
	N	584	224	154	526	300	1788
Snacking	MEAN	1.88	1.79	1.68	1.75	1.78	1.79
	SD	1.21	1.10	1.17	1.21	1.19	1.18
	N	591	227	155	531	301	1805
Overeat	MEAN	.54	.63	.63	.47	.54	.54
	SD	.85	.72	.94	.80	.82	.81
	N	587	225	155	530	299	1796

Outcome Variables		Never Smoker	Long-Term Quitter	Short-Term Quitter	Light/ Moderate Smoker	Heavy Smoker	Total
DIETARY COMPOSITION							
Salt	MEAN	1.67	1.66	1.80	2.33	2.81	2.02
	SD	.43	1.81	1.81	2.02	2.09	1.97
	N	593	226	152	529	301	1801
High Fat Meat	MEAN	1.90	1.77	1.88	2.05	2.33	1.99
	SD	1.29	1.06	1.31	1.31	1.37	1.29
	N	594	227	154	530	301	1806
Lean Meat	MEAN	1.76	1.70	1.57	1.59	1.33	1.62
	SD	1.24	1.15	1.03	1.21	1.22	1.21
	N	593	227	153	526	301	1800
Fish	MEAN	1.00	1.00	.97	.91	.76	.95
	SD	1.02	.94	1.02	.91	.85	.97
	N	586	226	154	525	297	1788
High-Fat Dairy	MEAN	1.12	2.07	1.75	2.16	2.33	2.15
	SD	1.51	1.39	1.48	1.53	1.63	1.57
	N	592	226	155	526	300	1799
Low-Fat Dairy	MEAN	1.34	1.50	1.09	1.04	.88	1.18
	SD	1.59	1.62	1.33	1.45	1.44	1.52
	N	592	226	155	529	300	1802
Butter, Lard, Fat on Meat	MEAN	1.38	1.21	1.54	1.65	1.80	1.50
	SD	1.45	1.11	1.51	1.54	1.52	1.48
	N	591	226	154	531	302	1804
Fried Foods	MEAN	1.79	1.57	1.73	1.86	2.00	1.80
	SD	1.27	.95	1.33	1.17	1.20	1.22
	N	593	226	153	530	302	1804

Outcome Variable		Never Smoker	Long-Term Quitter	Short-Term Quitter	Light/ Moderate Smoker	Heavy Smoker	Total
Refined Sugar	MEAN	1.70	1.54	1.67	1.42	1.51	1.60
	SD	1.30	1.12	1.41	1.25	1.26	1.31
	N	586	223	153	522	302	1786
Vegetables	MEAN	2.33	2.49	2.53	2.29	2.02	2.30
	SD	1.44	1.37	1.43	1.44	1.49	1.47
	N	593	223	154	530	302	1802
Fruit	MEAN	2.37	2.48	2.22	2.07	1.69	2.19
	SD	1.56	1.52	1.44	1.53	1.37	1.53
	N	587	223	155	527	298	1790
Fiber	MEAN	1.82	2.06	1.99	1.65	1.39	1.75
	SD	1.52	1.46	1.52	1.52	1.43	1.54
	N	594	224	154	530	302	1804
Polyunsaturated Fats	MEAN	1.54	1.54	1.42	1.50	1.47	1.49
	SD	1.31	1.38	1.32	1.29	1.39	1.33
	N	591	224	155	526	301	1797
Eggs	MEAN	1.33	1.32	1.42	1.33	1.31	1.32
	SD	1.21	1.05	1.32	1.25	1.13	1.27
	N	590	225	154	528	300	1797
Starches	MEAN	2.12	2.16	2.07	2.11	2.15	2.11
	SD	1.27	1.26	1.32	1.30	1.24	1.27
	N	590	225	154	528	301	1798

Outcome Variable		Never Smoker	Long-Term Quitter	Short-Term Quitter	Light/ Moderate Smoker	Heavy Smoker	Total
ALCOHOL/CAFFEINE							
Alcohol (drinks per week)	MEAN	4.40	5.20	4.77	8.70	10.04	6.53
	SD	10.03	5.87	7.84	12.80	15.11	11.45
	N	596	228	155	531	302	1812
Coffee (cups per day)	MEAN	1.21	1.81	2.29	3.05	4.75	2.35
	SD	1.87	2.61	2.46	4.14	3.89	3.10
	N	597	228	155	533	302	1815
Cola (drinks per day)	MEAN	2.03	1.94	1.77	2.31	2.50	2.16
	SD	2.13	1.54	1.98	2.31	2.55	2.19
	N	596	228	154	534	302	1814
Tea (glasses or cups per day)	MEAN	.69	.77	.87	.82	1.11	.81
	SD	1.68	1.69	2.04	1.80	2.66	1.90
	N	597	228	155	535	302	1817

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE	3. REPORT TYPE AND DATE COVERED
	December 1991	Interim

4. TITLE AND SUBTITLE Smoking Status and Body Composition, Exercise, Dietary Intake, and Alcohol/Caffeine Consumption

5. FUNDING NUMBERS
Program Element: 63706N
Work Unit Number:
NMPC Reimbursable and
M0095.005-6106

6. AUTHOR(S)
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7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Naval Health Research Center
P. O. Box 85122
San Diego, CA 92186-5122

8. PERFORMING ORGANIZATION
Report No. 91-22

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
Naval Medical Research and Development Command
National Naval Medical Center
Building 1, Tower 2
Bethesda, MD 20889-5044

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT

Approved for public release; distribution is unlimited.

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

Although research on smoking status and body composition reveals conflicting results, extant literature indicates that dietary intake, alcohol consumption, exercise, light/moderate versus heavy smoking, and the recency of smoking cessation are important variables to investigate. This study examined these variables in 1,820 Navy men. Of five body composition variables, only lean body mass was significantly ($p<.05$) related to smoking status. However, heavy smokers exercised the least and never smokers exercised the most. Heavy smokers also tended to eat high-fat meat more often, and eat lean meat, leafy vegetables, fruit, and fiber less often than all other groups. Long-term quitters were more similar to never smokers and short-term quitters more similar to light/moderate smokers in eating patterns and consumption of low-fat foods. Heavy smokers drank twice as much alcohol and caffeine as never smokers and former smokers. In summary, smoking was associated with very low levels of exercise, a high-fat diet, and heavy consumption of alcohol--all of which are associated with the leading causes of death and disability in the United States. Navy health promotion efforts should continue to encourage smokers to quit as well as to modify other negative health behaviors that may accompany addiction to nicotine.

14. SUBJECT TERMS Alcohol/Caffeine Consumption
Smoking Status and Body Composition
Exercise
Dietary Intake

15. NUMBER OF PAGES

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	Unlimited